

Selecting Treatment for Distal Ureteral Calculi: Shock Wave Lithotripsy versus Ureteroscopy

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Shock wave lithotripsy (SWL) and ureteroscopy (URS) are both effective treatments for removal of distal ureteral calculi, associated with high success rates and limited morbidity. The American Urological Association Ureteral Stones Clinical Guidelines Panel has found both to be acceptable treatment options for patients, based on the stone-free results, morbidity, and retreatment rates for each respective therapy. However, costs and patient satisfaction or preference were not addressed, and the report was based on data derived from older endoscopic and lithotripsy technology. Each of these treatment options has valid advantages and disadvantages. Both modalities are reasonable treatment options for the majority of patients with distal ureteral calculi. Whereas SWL is less invasive, the high, immediate success rate with minimal morbidity and decreased cost makes URS a very valid competitor. The results of treating patients with larger stones favor URS.

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The optimal therapy for patients requiring removal of distal ureteral calculi is controversial. Shock wave lithotripsy (SWL) and ureteroscopy (URS) are both effective treatments associated with high success rates and limited morbidity. Numerous retrospective analyses, as well as two prospective studies, have addressed this topic. In 1997, the American Urological Association Ureteral Stones Clinical Guidelines Panel established practice recommendations for the management of patients with ureteral stones. URS and SWL were both considered acceptable treatment options for patients with distal ureteral stones.¹ This recom-

mendation was based on the stone-free results, morbidity, and retreatment rates for each respective therapy. However, costs and patient satisfaction or preference were not addressed. This report was based on data that was derived from the utilization of older endoscopic and lithotripsy technology. We review select contemporary advantages and disadvantages of these two therapeutic approaches.

Stenting after Ureteroscopy

The need for ureteral stenting with URS has been considered a disadvantage because the majority of SWL procedures are performed without stents. Many studies comparing URS and SWL for treatment of patients with distal ureteral stones find that routine stenting of patients following uncomplicated URS adds to cost, operative time, and patient discomfort, thereby decreasing patient satisfaction.²⁻⁷ Stents with a tether can improve patient satisfaction and allow removal without the discomfort and cost of repeat cystoscopy. However, the routine use of ureteral stents following URS for distal ureteral calculi has been challenged. Recent prospective, randomized, controlled studies have compared stented and nonstented URS, demonstrating no differences in morbidity or stone-free status.^{2,3} This was also true for those individuals subjected to ureteral dilation.² Patients without stents had significantly less pain, fewer urinary symptoms, and decreased narcotic use postoperatively. Therefore it appears that stenting during uncomplicated URS is not necessary.

Cost-Effectiveness

Treatment costs are important in current medical practice. A number of investigators have compared the costs of SWL and URS in the treatment of patients with distal ureteral calculi. Francesca and associates and Kapoor

and colleagues reported that URS was less costly and more effective from a stone-free standpoint than SWL.^{8,9} However, Anderson and colleagues found that stone-free rates and costs were similar for both approaches.¹⁰ Wolf and associates developed a decision analysis model that compared the costs of these treatments.¹¹ Using this model, they found that the average cost for treating a distal

stones greater than 5 mm, all patients undergoing URS were satisfied, as compared to 95% of those undergoing SWL. However, a validated questionnaire was not utilized. In another prospective randomized study, Pearle and associates measured patient satisfaction following either SWL or URS.¹⁴ They reported that patient satisfaction was higher for SWL (96%) than for URS (89%), but not

URS patients without stents had significantly less pain, fewer urinary symptoms, and decreased narcotic use postoperatively.

ureteral calculus favored URS. Lotan and associates similarly utilized a different cost-effectiveness model and also found that URS was more cost-effective for patients with distal stones as well as stones in other ureteral locations.¹² Costs can also be influenced by hospitalization. However, the majority of patients undergoing either treatment modality rarely require postoperative hospitalization. It must be noted that these studies represent data collected at different times, in different manners, and in one instance from another country. However, the majority of these studies indicate that URS has an economic advantage.

Patient Satisfaction

There is no validated instrument available to assess patient satisfaction for either of these procedures. Nonetheless, this is an important concern from the patient's perspective. In a prospective randomized study, Peschel and associates measured patient satisfaction following either URS or SWL for distal ureteral calculi.¹³ For patients with stones less than 5 mm in diameter, all patients undergoing URS reported complete satisfaction, compared to 75% of patients undergoing SWL. For those with

at a statistically significant level. Additionally, patient willingness to undergo a repeat procedure of the same type favored SWL (100%) over URS (87%), but not at a statistically significant level. The satisfaction criteria in this study were more extensive. These studies demonstrate divergent patient satisfaction trends. This underscores the need for the development of a validated, stone-specific, quality-of-life instrument.

Efficacy

The major goal for treating patients with ureteral stones is a stone-free state. According to the American Urological Association's guidelines for the treatment of patients with distal ureteral calculi, SWL and URS are considered equally effective.¹ In this meta-analytic study, 85% of 9422 such patients subjected to SWL were rendered stone-free, as compared to 89% of 3978 such patients undergoing URS.

There have been two randomized, prospective studies comparing URS and SWL for treating patients with distal ureteral stones subsequent to the guidelines document. Peschel and associates randomized 80 such patients.¹³ They found that patients undergoing URS for distal ureteral

calculi could achieve stone-free status more rapidly, regardless of initial stone size, than patients subjected to SWL. All of the patients undergoing URS were rendered stone-free, whereas 10% of the SWL cohort required subsequent URS to achieve stone-free status. Pearle and associates randomized 64 such patients.¹⁴ They reported that 100% of individuals who completed radiographic follow-up subsequent to either SWL or URS became stone-free. One possible reason for the difference in this outcome compared to the prior study is that an unmodified HM3 lithotripter was utilized, rather than a Dornier MFL 5000; the former device is known to fragment stones more efficiently.

Similar treatment comparisons have been made with pediatric patients. Van Savage and associates reported a retrospective experience with pediatric patients harboring distal ureteral calculi.¹⁵ All patients undergoing initial SWL were rendered stone-free; 9% required repeat SWL. In contrast, only 88% undergoing initial URS were rendered stone-free. The failures all required antegrade interventions to become stone-free. The diminutive pediatric ureter may make URS a more challenging procedure in this patient population, whereas it does not appear to have a negative impact on SWL results.

Operative Time

Some investigators have reported that URS procedure times are shorter than SWL, and others have found them to be longer.^{13,14,16,17} These differences may be related to a number of factors, including surgical skill, ancillary staff, anesthesia time, fragmentation devices, stone size, and number of stones.

Fertility

Women of childbearing age have been historically excluded from SWL

of middle and distal ureteral calculi because it was thought that the effect of shock wave energy on the ovary might be deleterious. This has been investigated in animal models and clinical studies. McCullough and colleagues reported that shock wave energy did not have a significant impact on rat ovarian function and

undergoing URS. This is due to longer intraoperative fluoroscopic time and the need for more intense postoperative radiographic follow-up because stone evacuation is an ongoing event after SWL. This exposure to ionizing radiation is especially important for women of childbearing age. The less intense postoperative radiographic fol-

The quality and success rates of different SWL units are also of importance, because results may differ according to the lithotripter used.

did not cause teratogenic effects in offspring.¹⁸ Vieweg and associates performed a clinical retrospective study on the possible adverse effects of SWL on the female reproductive tract and found that SWL of lower ureteral calculi did not affect female fertility.¹⁹ Erturk and associates also reported that SWL was a safe treatment modality for women of reproductive age with distal ureteral calculi.²⁰ However, the aforementioned studies are limited by small numbers of subjects. Therefore, the safety of treating women of childbearing age and younger with SWL has not been established.

The fertility impact on men with distal ureteral calculi treated by SWL has also been investigated. Andreessen and colleagues assessed seminal parameters in men subjected to SWL for the treatment of such calculi.²¹ Although a decrease in sperm density and motility occurred immediately after SWL, these parameters had returned to normal by 3 months later. Martinez Portillo and associates reported similar, transient changes in seminal parameters in a subsequent study.²²

Radiation Exposure

Patients subjected to SWL have higher levels of radiation exposure than those

low-up in those subjected to URS is based on studies demonstrating that asymptomatic patients do not require routine postoperative imaging.²³ However, this has been challenged by the recent report by Weizer and associates, who found that approximately 3% of patients subjected to URS develop "silent" postoperative obstruction.²⁴

Anesthesia

Anesthesia can increase both the cost and risks of procedures. URS generally requires a regional or general anesthetic, whereas SWL can be undertaken with limited sedation or anesthesia when second- and third-generation lithotriptors are utilized. Jermini and associates reported SWL of distal ureteral calculi utilizing a Lithostar Ultra device.²⁵ Ninety-three percent of patients were treated without anesthesia or analgesia, and 90% of the patients were stone-free following treatment. Some groups have reported that URS can be performed using intravenous sedation in select patients.²⁶⁻²⁹ However, the urologic community has not embraced this practice.

Technology and Equipment

With the advent of newer-generation, smaller-caliber ureteroscopes,

the complication rates of URS have decreased significantly in the hands of experienced urologists.^{14,16} Ureteroscopes are also readily available to the urologist, whereas SWL units may be available only at certain times or

with URS in contemporary series have ranged from 0%–4% and 0%–2%, respectively.^{13,14,17,30–32} Serious complications associated with URS have decreased with time, largely due to both advancing technology, includ-

outcomes with URS, whereas the results with smaller stones are equivalent.^{30,31,34} However, treatment times have been reported to be significantly longer with URS in patients harboring large-volume calculi.

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locations. In addition, purchase and maintenance costs of SWL are substantially higher.

The quality and success rates of different SWL units are also of importance, because results may differ according to the lithotripter used. Comparison studies have routinely been performed with older-generation lithotriptors such as the Dornier HM3 device, which has a larger focal zone resulting in better fragmentation. Therefore the results of studies are machine-specific and cannot be translated to use with other lithotriptors.

Complications

Complication rates are low for both treatment options. The rates for ureteral perforation and ureteral stricture

ing smaller-caliber ureteroscopes and safer intracorporeal lithotripsy devices, as well as increased surgical skill. Complications related to SWL are typically less severe than those related to URS and are related to stone fragment passage.

Stone Composition

Cystine, brushite, and calcium oxalate monohydrate stones are more refractory to SWL, whereas all of these calculi can be readily fragmented with the Holmium:YAG laser.³³

Number of Stones and Stone Size

Retrospective and prospective studies have demonstrated that patients with stones greater than 8 mm or multiple ureteral stones have better stone-free

Conclusions

Supporters of SWL claim that it is effective and noninvasive, is associated with less morbidity and requires less anesthesia than URS, and seldom requires ureteral stents. Critics argue that the success rates are not as high as URS, equipment availability may be limited, visualization of the stone is often difficult, attaining a stone-free state requires a longer period of time and follow-up, retreatment rates are higher, radiation exposure is increased, and cost is higher.

Supporters of URS claim that it is highly successful and minimally invasive, is associated with minimal morbidity in the hands of skilled urologists, can be used with larger and multiple stones, and has high immediate stone-free rates possibly resulting in decreased patient anxiety and resultant increased patient satisfaction. It is also less expensive compared to SWL and is the treatment of choice in many settings of

Main Points

- Studies comparing ureteroscopy (URS) and shock wave lithotripsy (SWL) find that routine stenting of patients following uncomplicated URS adds to cost, operative time, and patient discomfort; however, recent studies have compared stented and nonstented URS, demonstrating no differences in morbidity or stone-free status.
- The majority of studies comparing treatment costs of SWL and URS indicate that URS has an economic advantage.
- Levels of radiation exposure are higher with SWL than with URS because of longer intraoperative fluoroscopic time and the need for more intense postoperative radiographic follow-up.
- URS generally requires a regional or general anesthetic, whereas SWL can be undertaken with limited sedation or anesthesia when second- and third-generation lithotriptors are utilized.
- With newer-generation, smaller-caliber ureteroscopes, the complication rates of URS have decreased significantly in the hands of experienced urologists.
- Complication rates are low for both treatment options. Serious complications associated with URS have decreased with advancing technology and increased surgical skill; complications related to SWL are typically less severe than those related to URS and are related to stone fragment passage.

failed SWL. Critics argue that it requires specialized training, requires more anesthesia, more often requires stent placement (however, this is debatable), more often requires overnight hospitalization, and possibly has higher complication rates.

It is apparent that this topic can be extensively debated and that each of these treatment options has valid advantages and disadvantages. Both modalities are reasonable treatment options for the majority of patients with distal ureteral calculi. Whereas SWL is less invasive, the high, immediate success rate with minimal morbidity and decreased cost makes URS a very valid competitor. The results of treating patients with larger stones favor URS. Continued studies are warranted to better define the roles of each in the management of patients with distal ureteral calculi because both are highly effective. Secondary outcomes such as quality of life and economic factors will become more central issues in this ongoing debate. ■

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